North Idaho Phosphate Company
Silver King community
Kellogg
Shoshone County
Idaho

HAER No. ID-30

HAER
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40-KELL,
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PHOTOGRAPHS

WRITTEN HISTORICAL AND DESCRIPTIVE DATA

Historic American Engineering Record
National Park Service
Western Region
Department of the Interior
San Francisco, California 94107

HISTORIC AMERICAN ENGINEERING RECORD

NORTH IDAHO PHOSPHATE COMPANY HAER No. ID-30

Location:	Silver King, near Kellogg, Shoshone County Idaho U.S.G.S. 7.5 minute Kellogg West, Idaho quadrangle, Universal Transverse Mercator coordinates: 11.562580.5264940, 11.562560.5264720, 11.562420.5264710, 11.562410.5264840, 11.562520.5264940
Date of Construction:	1959-1960. Altered 1961, 1965, 1973.
Project Manager:	Emmett Waltman
Engineering Design:	Dorr-Oliver Incorporated
Builders:	Bumstead-Woolford Company Collier Carbon and Chemical Corporation Henry George and Sons Bird Machine Company Swenson Evaporator Company Dix Steel Company Stauffer Chemical Company
Present Owner:	Pintlar Corporation, Kellogg, Idaho
Present Use:	Idle fertilizer manufacturing plants scheduled for demolition in 1994.
Significance:	Seeking expanded utilization of byproduct sulfuric acid, Bunker Hill built a plant for the production of phosphoric acid from phosphate ore in 1960. Addition of ammonium phosphate fertilizer production and storage facilities in 1965 provided a variety of chemical fertilizers for sale, which increased the usage of Acid Plant H_2SO_4 output, thus helping the Bunker Hill Zinc Plant and Lead Smelter to meet environmental standards and remain in operation.
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Date:	September 1993

I. Historical and Descriptive Narrative

A. Historic Background- The Bunker Hill Company's Sulfuric Acid Production and the Phosphate Fertilizer Market

Bunker Hill, through its Sullivan Mining Co. Electrolytic Zinc Plant, entered the sulfuric acid market in 1954, when their first Acid Plant began converting sulfur dioxide gas into the salable acid product. Demand for this product had grown to the point where supply shortages were occurring, causing smelting and refining concerns, like Bunker Hill, to examine the conversion of waste sulfur dioxide gas into sulfuric acid. Use of sulfuric acid in the manufacture of fertilizing agents for the agricultural industry had fueled much of the demand for H_2SO_4. It was one of the essential components, along with phosphate rock and ammonia, for the production of these agents. Phosphate fertilizers promoted plant growth by enriching phosphate deficient soil, thus greatly increasing yields in many agricultural areas of the United States, where decades of farming had exhausted the soil of essential elements like phosphorus and nitrogen. Erosion of the depleted and unproductive soils furthered the problem. Treatment of these areas with chemical fertilizers presented the prospect of restored productivity and, with subsequent growth, reduced erosion. The resultant need for phosphorous, nitrogen (in the form of anhydrous ammonia [NH_3]), and sulfuric acid triggered growth in the industries that produced them. Primary production (98%) of phosphate rock was centered in the Phosphoria formation (Southwestern Montana, Eastern Idaho, Western Wyoming, and Northern Utah) and in Florida's "pebble phosphate" region.[1] Ammonia production occurred in oil producing areas that also possessed cheap natural gas, such as the Texas Gulf Coast, Oklahoma, Wyoming, and Alberta, Canada. Sulfuric acid production was not as narrowly tied to geographic constraints. Any plant that had byproduct sulfur dioxide in sufficient strength could consider the installation of process equipment for the conversion of SO2 to H2SO4. Smelters and refineries throughout the United States were in a position to take advantage of this, which the Sullivan Mining Company did with the construction of the Acid Plant in 1952-54.

Production and sale of byproduct sulfuric acid was a first step toward involvement in the fertilizer market. The succeeding steps would be direct manufacture of phosphoric acid and ammonium phosphate fertilizers, which would require access to the other process materials and a facility with the necessary production equipment. The close proximity of the Montana section of the Phosphoria to Bunker Hill's mining and smelting operations led the Company to investigate the geology and availability of phosphate holdings there in 1955-59.[2] The well established production of phosphate rock from mines in Southeastern Idaho promised a readily purchaseable supply of material also. In that same era, The Bunker

Hill Company studied the possibility of siting and erecting a facility for the production of phosphoric acid.

B. Historic Background- The Bunker Hill Phosphoric Acid Plant, Location Planning and Construction

In his 1958 annual report, John Bradley, Bunker Hill's president, informed stockholders that the Company was going to expand into fertilizer production with the building of a new plant. The site of this plant was still under investigation, the studied locations being Kennewick, Washington (the Tri-Cities area) and Kellogg, Idaho.[3] Kennewick had the reported advantages of lower labor and housing costs and savings related to milder weather, i.e. lack of snowloads on the facility structures. Emmett Waltman, the Project Manager, and Bunker Hill Manager of Engineering, LeVern M. Griffith, questioned these savings, citing an important factor in Kellogg's favor: "We believe that one of the big advantages to the Kellogg location is the utilization of the existing organization, services, and facilities, with a minimum of additional cost to the Company."[4] Their choice of Kellogg was broken down into three potential plant sites: 1) Silver King, north of the Zinc Plant, 2) the ridge top behind and south of the Lead Smelter, and 3) the area adjacent to the Bunker Hill Concentrator (West Mill) on West McKinley Avenue. All of the sites possessed similar advantages, but the Smelter area would require improved rail and road access, and the West McKinley site would call for removal of present occupancy, and would necessitate the building of a longer sulfuric acid pipeline than the other sites required.[5]

The problem of sulfuric acid transport was another factor of significance in consideration of the Kennewick location. It was indicative of Bunker Hill's serious intentions regarding that site that the Company conducted a feasibility study of an acid pipeline to the Columbia River location.[6] It would have to cover a distance of nearly two hundred miles, and climb two elevational grades before descending into Kennewick. Additionally, there would be four water crossings. Costs of installation and maintenance would be greatly magnified over that distance. In the end, the presence of The Bunker Hill Company organization and the availability of building sites within the Kellogg area induced the Company to build locally, adding a fifth element to their existing complex of Mine and Mill, Lead Smelter, Zinc Plant, and H_2SO_4 Acid Plant. Construction of the Phosphoric Acid Plant began on the Silver King site in September of 1959. Photograph ID-30-1 shows the Phosphoric Acid Plant after the completion of construction.

The plant that was built by the Bumstead-Woolford Company of Seattle and their Spokane, Washington subcontractors, Henry George and Sons was completed by July of 1960. It was engineered according to specifications supplied by Dorr-Oliver, Inc. of Stamford, Connecticut, "with a designed capacity of 23,000 tons per year [@ 70 T/day] of P_2O_5 as 52% phosphoric acid."[7] A separate unit, attached to the northeast corner of the Main Building, was added in 1965 by the Collier Carbon and Chemical Corporation of Los Angeles for the production of a more concentrated form of the acid (70% P_2O_5) known as Anhydrous Liquid Phosphate or "green acid."[8] Besides the Main Building, with its process equipment, there was a Track Hopper Building (for receipt and unloading of phosphate ore), Storage Silo (to which the ore was conveyed), three Acid Storage Tanks, an H_2SO_4 Acid Pump House, Fire Pump House, and three Storage Buildings (used by the contractors during construction of the Main Building and other facilities).[9] The Bunker Hill Phosphoric Acid Plant was the first operational unit of a facility that, when added to in 1965, would produce ammonium phosphate fertilizers along with various grades of phosphoric acid.

C. The Layout and Operations of the Phosphoric Acid Plant

The Phosphoric Acid Plant was situated on the floor of Government Gulch, with the Union Pacific Railroad line on the plant's eastern flank. To its south were the H_2SO_4 storage tanks utilized by the sulfuric Acid Plant located within the Bunker Hill Zinc Plant (and by the Lead Smelter's Acid Plant, after 1970), which was further up Government Gulch. The phosphate ore used by the Phosphoric Acid Plant was mined, crushed and finely ground prior to shipment; if the rock contained significant quantities of carbon-held impurities, it was also calcined in a roaster at the plant of origin.[10] Unit trains made up of eleven hopper-cars delivered phosphate rock to the Track Hopper Building for unloading. From there the rock was conveyed up into a feed hopper, which continuously supplied the Thayer scale that "weigh[ed] and discharge[d] rock to the reactor system. Overflow from the feed hopper travel[ed] on an air slide to the storage silo."[11] The Storage Silo had a capacity of 1800 tons. When rock wasn't being unloaded from a unit train, stored phosphate rock was drawn from the Silo and elevated to the feed hopper.

The Thayer scale provided a measured feed of phosphate rock to a mixing cone, "where it [was] mixed with return acid (which include[d] filtrate from gypsum washing in the filter, Doyle scrubber effluent, and condensate from the evaporation process).[12] The slurry that was formed entered the two compartment reactor tank, or digester. A "vee-notch weir permit[ted] a measured flow adjustment of the return acid to provide an optimum slurry (29-31% solids) to the reactor."[13]

The cylindrical reactor tank was made up of an outer, annular compartment and a cylindrical inner compartment. Four agitators, spaced at intervals within the annular compartment, moved the slurry clockwise around the compartment. 70° clockwise from where the slurry was introduced, measured amounts of H_2SO_4 entered the tank to initiate the exothermic reaction that diluted the sulfuric acid and digested the phosphate slurry, producing phosphoric acid and byproduct calcium sulphate (gypsum).[14] 260° past the point where slurry was added to the reactor it flowed through an "opening in the bottom of the vertical wall of the inner compartment- this allow[ed] flow of reacted material from the annular reaction space to the inner compartment."[15] Most of the slurry recirculated through the annular chamber.

The inner compartment served to stabilize the reaction and provide further cooling of reacted slurry. As "both the dilution of sulfuric acid and the reaction between phosphate rock and sulfuric acid [were] exothermic reactions, air cooling [was] utilized within the reaction and stabilization chambers to maintain a slurry temperature near 80° C."[16] The slurry flowed from the reactor's inner compartment through a launder located at the top of the stabilization chamber to the filter feed tank.

Contaminants in the phosphate ore (such as calcium fluoride, sodium oxide, potassium oxide, silica, ferric [or aluminum] oxide, and calcium carbonate) reacted with the H_2SO_4, water, "and other reaction products [to produce] a number of solid, liquid, and gaseous waste products (including gypsum, fluorosilicates, hydrofluoric acid, fluorosilicic acid, ferric or aluminum phosphates, and silicon tetrafluoride)."[17] An exhaust fan pulled gases from the reaction through ducts equipped with water sprays. The water reacted with the silicon tetrafluoride gas to produce fluorosilicic acid and silica (which was washed from the duct by the water). The exhaust fan then drew the gases through a Doyle (venturi) scrubber for capture of the solids and liquid particulates. The scrubber effluent was recycled to the filter wash tank for subsequent use in washing the gypsum retained in the Bird-Prayon filter pans, and the cleaned emissions were exhausted out the plant stack.

Slurry was pumped from the filter feed tank into one of the 16 filter pans of the Bird-Prayon unit, which was a rotating, tilting-pan vacuum filter. Separation of 27% phosphoric acid from the gypsum waste product was accomplished in the Bird-Prayon vacuum filter. Filtered acid flowed to the strong acid storage tank, leaving behind a cake of gypsum crystals. The cake in the filter pan was "subjected to a counter-current series of washes ending with a hot water wash to attain maximum recovery of phosphoric acid."[18] Weak acid (13% P_2O_5) from intermediate washing flowed to the return acid tank for use in the reaction tank. Filtrate from the hot water wash was held for use in following intermediate washes. At the conclusion of washing, the filter pan was inverted and the gypsum was blown out of the pan and into a hopper. The filter cloth was washed with water, and that water formed a slurry with the gypsum cake, which was pumped into a settling pond for disposal. The pan was "returned to operating position, dried, and filter feed [was] then recharged to the filter pan and the cycle repeated."[19] Use of all 16 of the filter pans in sequence provided filtration and acid collection on a continuous basis. Filter efficiency was directly related to the operation of the reaction facilities. It was essential to control the initial reaction and the type of gypsum crystals formed, or poor filter recoveries would occur. If these processes weren't closely controlled, the gypsum crystals would "paste up" and inhibit the extraction of phosphoric acid.[20] Photograph ID-30-2 shows the 32 ft., 3 in. diameter Bird-Prayon filter.

The 27% phosphoric acid that was obtained from the Bird-Prayon filter required concentration to 52% strength before it was a profitable product. To achieve this, the acid was pumped into and circulated through a Swenson evaporator. The Swenson unit, which had a vertical steam heating element on its exterior, operated "under vacuum and [was] arranged with vacuum lines exiting through a barometric condenser to accomodate the separation of water vapor and non-condensables from the concentrated liquor."[21] The corrosive phosphoric acid and "scale forming properties [made] the process a complicated chemical engineering operation- boiling should be prevented in the tubes and supersaturation minimized to minimize the rate of nucleation and scale formation (thus maintaining optimum heat transfer conditions)."[22]

The 52% orthophosphoric acid that was obtained by this process flowed into a distribution box which discharged acid into one of three 1000-ton thickener tanks on the north side of the plant's exterior. As 52% acid was withdrawn, more 27% phosphoric acid was added to maintain a system balance. Solids in the 52% acid settled during the two weeks that the "acid [was] allowed to cool and stand in storage- clarification by sedimentation occur[red] in the thickeners."[23] The clarified 52% acid product was pumped to acid loading racks for shipment by rail and truck tank-cars to market. Thickener tank sludge was pumped to the return acid tank for use in the reactor. Bunker Hill shipped its first phosphoric acid manufactured by this plant in February, 1961.[24] This initial unit of the Phosphoric Acid/Fertilizer Plant operated three shifts per day/seven days a week. It employed "nine operators per day, plus any required maintenance personnel."[25] The plant was superintended by Dean Wilde, who had conducted research for Bunker Hill on the subject of fertilizer manufacture a decade earlier.[26] A need for increased 52% acid storage capacity led to the installation of a 2000-ton capacity tank adjacent to the three existing tanks in the summer of 1961. It enabled "the Company to continue production of acid during slack sales periods."[27] These "slack sales periods" attested to the cyclical nature of fertilizer use by agricultural concerns, and the value of having a large quantity of product available when the demand peaked.

Production of super-phosphoric "green" acid (SGA), also known as Anhydrous Liquid Phosphate, was begun in 1965. Further concentration of 52% orthophosphoric acid produced a 70% pyrophosphoric acid.[28] 52% product acid was "pumped to a hot well, then pumped in a circulation system from the hot well over the top of a falling film type heat exchanger, through a flash chamber (under high vacuum), and returned to the hot well."[29] Dowtherm A, (a Dow Chemical, oil-based compound) was used as the heating medium for the evaporation of additional water from the 52% acid. The Dowtherm A was "vaporized in a boiler and delivered to the evaporator at 3-5 psi [and 260° C.]...condensed Dowtherm A vapors [were] returned to the boiler."[30] When the acid approached 68% strength, it was continuously drawn "from the circulating acid system and placed in a cooling tank. The circulating system [was] continually recharged with the required amount of 52% acid for makeup feed- maintaining a system balance."[31] Cooled SGA flowed to an insulated and agitated storage tank. This tank was situated to the north of the other tank group, and adjacent to the plant's H2SO4 storage tank. To keep the SGA at a pumping viscosity, a 170-175° F. temperature was maintained within the 30 ft. diameter by 24 ft. high insulated tank. Insulated rail and truck tank-cars received acid that was pumped through heated lines.[32] Upon conclusion of loading, the pump was reversed to clear the line of residual SGA, to avoid line freezing.

Both the 52% and the 70% P2O5 phosphoric acid were sold for use in manufacturing chemical fertilizers (the "green" acid being produced under contract to the Collier Carbon Company). The next logical step in expanding plant output for market utilization would be production of ammonium phosphate fertilizers on site. With the signing of a joint venture agreement on September 11, 1964, Stauffer Chemical Company of San Francisco and The Bunker Hill Company formed the North Idaho Phosphate Co. as the entity for continued operation of the Phosphoric Acid Plant, operation of fertilizer production and storage/shipping additions (to be built in 1965), and marketing of the NIPCO plants products.[33]

D. North Idaho Phosphate Company: Additions and Operations 1965-70

The North Idaho Phosphate Company incorporated large quantity dry fertilizer storage capacity into the facilities that took shape during the course of 1965, building a 200 ft. by 200 ft. by 60 foot high Shipping and Storage Warehouse alongside the fertilizer production facility known as the Ammonium Phosphate Plant (AMP). Bunker Hill engineer Gordon Langford coordinated the implementation of these additions, which were constructed with the participation of the Dix Steel Company of Spokane, Washington. Construction plans were to include the erection of an "office and enlarged change room facilities."[34] The Ammonium Phosphate Plant was constructed to the immediate south of the Phosphoric Acid Plant, with the Office adjacent to it on the west. Further south of these buildings was the Shipping & Storage Warehouse. Pipelines connecting the Phosphoric Acid Plant and the AMP allowed transfer of acids for fertilizer production.

The completed North Idaho Phosphate AMP Plant was designed as an 80%-sized copy of Stauffer's Salt Lake City, Utah plant.[35] Its output was various grades of pelletized ammonium phosphate fertilizer (sold in bulk or bags). Pelletized fertilizers were typically classified according to percentages of nitrogen (N), phosphorus (in the form of P_2O_5), and potassium (in the form of potash- K_2O). The market for the NIPCO plant's output was the Pacific Northwest where, "due to the soil conditions found in the Northwest, none of the Plant's solid fertilizers contain any potash."[36] North Idaho Phosphate briefly experimented with a 12-12-12 product, but dropped it from production when it proved unprofitable.[37] Such attempts to diversify plant output by testing market acceptance of new fertilizer products were an ongoing feature of NIPCO's productive life. The chief grades produced at the North Idaho Phosphate Plant were:

N%	P2O5%	K2O%
16	20	0
13	39	0
11	48	0
18	46	0

Production began at the AMP Plant in November of 1965 under Kenneth Haight, Wilde's successor as Superintendent. The Shipping and Storage Warehouse was still under construction at that time. The Bunker Hill Company operated the completed plant, with Stauffer Chemical being responsible for production planning, sale of the finished products and accounting services.[38] Burt Van Riel, a Stauffer Chemical Engineer, assisted in the startup of the Fertilizer Plant, which was "scheduled to produce between 50 and 60 thousand tons of fertilizer a year."[39] Photograph ID-30-3 shows the AMP Plant during construction.

The fertilizer manufacturing process employed inputs of phosphoric acid, anhydrous ammonia (NH_3), and sulfuric acid (H_2SO_4). Both 27% P_2O_5 acid and 52% P_2O_5 orthophosphoric acid were piped from storage in the Phosphoric Acid Plant, along with tank sludges and filter feed slurry. The anhydrous ammonia arrived by rail in tank cars, and it was stored in a tank between the Phosphoric Acid and Fertilizer Plants (a second tank was added in the seventies). H_2SO_4 obtained from the Zinc Plant storage site was piped in from a holding tank at the Phosphoric Acid Plant.

One grade of fertilizer was made at a time. The stronger grades required less of the gypsum filler in the slurry (with the 18-46-0 using 52% acid and minimal thickener sludge or filter feed), while a weaker grade, like 16-20-0, was made up with 27% P_2O_5 and more filler.[40]

Typical AMP Plant operation was as follows: the 27% P_2O_5 acid was first "circulated through the S. F. and Aerotec scrubbers where it scrub[bed] particulate emissions and any free ammonia released in the plant operations;"[41] after collecting vapors, liquids, and solids in the scrubbers, the phosphoric acid was combined with sulfuric acid and ammonia in the first of a series of reactors, which produced a "molten" slurry, while generating exothermic heat; when analysis of the slurry showed crystal formation sufficient enough to produce fertilizer pellets, the mix was fed into a

Spencer pug mill; recirculated material from succeeding product screening was added to the mill to provide nuclei for the formation of pellets.[42] A constant flow of return granular material was used to collect and combine with the reactor slurry. An estimated "80 to 90 tons of material continually recirculate[d] in the system...about five times through this pelletizing section before leaving the plant as a properly sized finished product."[43] Exhaust gases and entrained particulates from the reaction tanks and the pug mill were collected in a duct system and drawn through the Aerotec scrubber where the vapors were condensed or reacted with the scrubbing acid and, along with particulates, were removed from the exhaust stream.

The pelletized granular material that came from the pug mill was fed on a continuous basis into a Renneberg rotary dryer. The pellets had their moisture content reduced and their structure stabilized in this 60 ft. long by 8 ft. diameter dryer. Dried pellets were then conveyed onto a Novo double deck screen, which separated the oversize fraction from the product-sized pellets. Product pellets were conveyed by a vibratory feeder into a Renneberg cooler, while the oversize was fed into a hammermill for pulverization. The broken up oversize fraction and screening fines were returned as feed to the pugmill. Collection hoods and a duct system on the dryer, product screening, and fine fraction recycle system conveyed gases and particulates through a cyclone (which collected particulates and returned the material to the fine fraction recycle system); exhaust from the cyclone was then drawn through the S. F. scrubber where vapors were condensed or reacted with the scrubbing acid and, along with particulates, were removed from the exhaust stream.

Product pellets underwent a final pass through a Rotex double deck screen after cooling. This served to separate any residual oversize and undersize fractions from the finished product. The pellets were transferred to the Shipping and Storage Warehouse, while the oversize and undersize fraction materials were recirculated back to the pug mill. A Micro-Pulsaire baghouse received particulates collected by ducts and hoods along the recirculating conveyor's path. This fine material was also returned as pug mill feed, while an an exhaust fan discharged cleaned gases into the atmosphere.

The fertilizer pellets were stored in bins by grade. Before shipment, they were screened again to remove dust, and then either shipped in bulk or in fifty and eighty-pound bags of multiple wall construction. Shipment was by truck and rail.

Burt I. Lipshay succeeded Kenneth Haight as Superintendent of the North Idaho Phosphate Company in 1966. Lipshay came to the Kellogg operation from the Stauffer fertilizer plant at Tacoma, Washington.[44] As a Stauffer employee, experienced in the operation of ammonium phosphate fertilizer plants, Lipshay represented a more direct involvement by Stauffer in the daily operations of the North

Idaho Phoshpate Company, although the plant continued to be staffed by Bunker Hill operators.

In 1967, Bunker Hill's representative on the joint venture committee for NIPCO, George A. Larson, informed company president Charles E. Schwab that "Collier Carbon and Chemical Corporation has approached us with the idea of joining forces in a venture to produce ammonium sulfate, a dry pellet fertilizer product."[45] Collier Carbon was in the process of constructing an ammonia production plant in Alaska, and they were looking for marketing outlets. Bunker Hill was attracted to the proposal initially, because it would mean increased utilization of their sulfuric acid output, which had been doubled by the addition of a second unit at the Zinc Plant's Acid Plant that same year. The proposal advanced to the planning stage, an event announced by the Bunker Hill Reporter in April, 1968, which stated that "ammonium sulfate fertilizer has a wide variety of agricultural uses and is applied extensively in the Palouse and other wheat growing regions to replace soil's nitrogen content."[46] The Palouse wheat-farming area was an agricultural market that was geographically close to the North Idaho Phosphate Plant, thus providing more weight to the plans for a new facility. In spite of these favorable factors, the project languished in the planning stage.

By 1969, the North Idaho Phosphate Company joint venture had to deal with a more pressing issue, that of gypsum disposal. The calcium sulphate byproduct of phosphate rock digestion and slurry filtering was similar to the dry gypsum that was mined for use in manufacture of the building material known as "sheetrock," but the need to dry it prior to use, the large quantities produced by the Phosphoric Acid Plant, and trace presence of corrosive phosphoric acid, made it an unmarketable waste.[47] In 1960, Gypsum slurry had originally been impounded in Magnet Gulch, to the southeast of the Lead Smelter. By 1964, the original impoundment had filled with gypsum necessitating construction of a second impoundment northeast of the Smelter, on the valley floor. By 1969, production of gypsum would soon exceed the capacity of the second disposal area, leading NIPCO to plan for and build a third impoundment between the Lead Smelter's granulated slag pile and the Central Impoundment Area, on the broad flat of the valley below the Smelter. Construction of a 6000-foot line was begun in May, 1969, and the new impoundment began receiving gypsum slurry in 1970.[48] This pond continued to serve the North Idaho Phosphate Plant until operations ceased in 1981. This final impoundment differed from the prior impoundments in that "a decant and recycle pumping lagoon were included...to recycle all process effluent water back to the phosphoric acid plant."[49] Recycling was implemented in 1974, and by 1979, the NIPCO plant was utilizing a floating decant to directly supply the pumps, obviating the need for a separate recycle lagoon.

E. North Idaho Phosphate Company Operations 1970-81

Joseph D. Acree transferred from Stauffer's Salt Lake City, Utah fertilizer plant in 1970 to succeed Lipshay as superintendent of the Kellogg plant, when Lipshay took a different position with The Bunker Hill Company. At the time of his arrival, equipment maintenance concerns in the Phosphoric Acid Plant led him to report that "the original weak design in the carriage support rails for the Bird-Prayon filter used to separate the byproduct gypsum from our phosphoric acid has led to continuing maintenance problems."[50] The corrosive nature of phosphoric acid was one source of this and other maintenance difficulties, but the mechanical wear occassioned by ten years of continuous operations were becoming apparent in plant process equipment maintenance costs and frequent operations down time.

Improvement in the fertilizer market in 1972, after several years of product surpluses, helped to put the North Idaho Phosphate Company on a more profitable footing. Acree was able to predict that "sales of ammonium phosphate will surpass any previous year by between 15 and 20 percent."[51] It was shortly after this time, in 1973, that the North Idaho Phosphate Company authorized plant improvements, in the form of a new Change House (a trailer adjacent to the Phosphoric Acid Plant), a rigid structure Maintenance Shop (also next to the Phosphoric Acid Plant), and a Lunch Room (west of the Warehouse). Another small facility was built to house 50-lb. bags of diatomaceous earth (clay) to be used in the manufacture of a new product- a liquid suspension fertilizer.

The new product, a 9-30-0 grade fertilizer, was mixed in a tank in the Liquid Suspension Plant, located immediately east of the Phosphoric Acid Plant. 52% P205 acid was piped into the tank, followed by additions of anydrous ammonia. When a slightly acid condition was present, 70-80 bags of the clay were added to the batch and mixed in. Ph levels were sampled down through the mix until the slight acidity was uniform, then specific gravity was checked and modified, if necessary. A final addition of 70% P205 acid brought the product up to grade, and it was ready for pumping into a truck tanker.[52] Liquid suspension fertilizer was produced between the years 1973-77, at which time manufacture of the product was discontinued.

The fertilizer market had entered another downturn in 1975, when overseas exports of chemical fertilizer dropped, aggravating the normal cyclically low sales.[53] Bunker Hill and Stauffer continued operating the North Idaho Phosphate Plant through this slump, but by 1980, Stauffer was interested in dissolving the joint venture, with formal withdrawal finally being planned at the end of 1981.[54] As part of this plan, Acree was transferred to another Stauffer plant, and Bunker Hill appointed Robert Smith as Superintendent during the last year of operation for the North Idaho Phosphate Co. Closure of all Bunker Hill facilities was announced at the end of August, 1981. As of 1993, the plant stood idle and partly dismantled. Its Maintenance Shop and various electrical and mechanical equipment were sold and removed in the intervening years. As an element of the Bunker Hill Superfund Site, the North Idaho Phosphate Company Plants are scheduled for demolition in place.

The North Idaho Phosphate Company made productive use of byproduct sulfuric acid generated at the Zinc Plant's Acid Plants (and Lead Smelter, after 1971), turning out salable products, and enabling the continued operation of Bunker Hill's other plants. From a small Phosphoric Acid Plant, employing about 15 people, the operation expanded into a production facility staffed by 35 employees and capable of manufacturing a variety of fertilizer products.[55] Photograph ID-30-4 shows the plant after 1965.

Although the North Idaho Phosphate Company operated for more than twenty years, the plant employees did not organize a 20-year service club as was done at the other Bunker Hill operations. The initial plant staff was largely drawn from the workforce at the Zinc Plant, and former Phosphoric Acid/Fertilizer Plant employees attend the annual meeting of the Zinc Plant Twenty-Year Club.

Employees like Kenneth Haight transferred their operations knowledge, gained at the Zinc Plant, to the Phosphoric Acid Plant, giving the inaugural production of the new plant a staff of experienced operators. Many of the Phosphoric Acid Plant employees (such as Larry Oneslager, Fred Camm, Bob Cadell, Paul Siegfried, Bill White and Pete Koole) were also veterans of the Zinc Plant. Other employees, like Jerry Martello, came from families long associated with the Bunker Hill and Sullivan Mining Companies (Mr. Martello's father had been a supervisor at the Zinc Plant). Martello started at the Phosphoric Acid Plant as a young man, advancing to supervisory positions within the operation, including that of interim Superintendent of the North Idaho Phosphate Company. As with the other Bunker Hill operations, experience and ability were rewarded with promotions. Photograph ID-30-5 shows the North Idaho Phosphate Company operating staff in 1965.

The North Idaho Phosphate Company drew upon the expertise of people who had gained working experience from long association with chemical applications and fertilizer manufacturing. Kenneth Haight had been a chemist at the Zinc Plant before he transferred to the Phosphoric Acid Plant, eventually succeeding Dean Wilde as Superintendent. Burt Lipshay and Joe Acree had built careers in the fertilizer industry before coming to NIPCO as Superintendents. Ray Dose, who became involved in solving plant mechanical problems as a Maintenance Supervisor, had gone from part-time work in an Oklahoma phosphate plant (while in college) to a position in the fertilizer division of Lonestar Gas, Inc. of Texas, prior to his employment with the North Idaho Phosphate Company. Together with the Zinc Plant derived staff of operating and maintenance personnel (and many others), these workers produced high quality phosphoric acids and ammonium phosphate fertilizers for the Western market.

F. North Idaho Phosphate Company Building Structural Information (Refer to numbering on Figure 1).[56]

1.) Phosphate Unloading Building: Built 1960 (asbestos clad steel frame); 1,150 sq. ft.

Phosphate ore was received here, prior to being conveyed to the Thayer scale. A portion went on to the reactor tank, with the overflow going to the Storage Silo.

2.) Suspension Plant Storage Building: Built 1973 (metal clad steel frame); 576 sq. ft.

Liquid suspension fertilizer (manufactured by the North Idaho Phosphate Plant between 1973-77) was stored here.

3.) Storage Silo: Built 1960; 1800 ton capacity.

Phosphate ore was drawn from here for conveying to the reactor when unit train hopper cars weren't being unloaded.

4.) Acid Storage Tank: Built 1961; 2000 ton capacity.

This tank was added to provide greater storage capacity for 52% orthophosphoric product acid.

5.) Acid Storage Tanks: Built 1960; 1000 ton capacity each.

These were the original storage and thickening tanks at the Phosphoric Acid Plant.

6.) Phosphoric Acid Plant: Built 1960 (asbestos clad steel frame); 20,640 sq. ft.

The Main Building of the original plant, this facility contained the reactor tank, Bird-Prayon filter, Swenson evaporator, and related process equipment for the manufacture of 52% orthophosphoric acid.

7.) Maintenance Shop: Erected 1973 (rigid steel structure); removed post-1982.

8.) Dry Room: Set in place 1973 (work trailer); 380 sq. ft.

This served as a change house for plant employees.

9.) <u>Ammonium Phosphate Manufacturing Building</u>: Built 1965 (asbestos clad steel frame); 20,000 sq. ft.

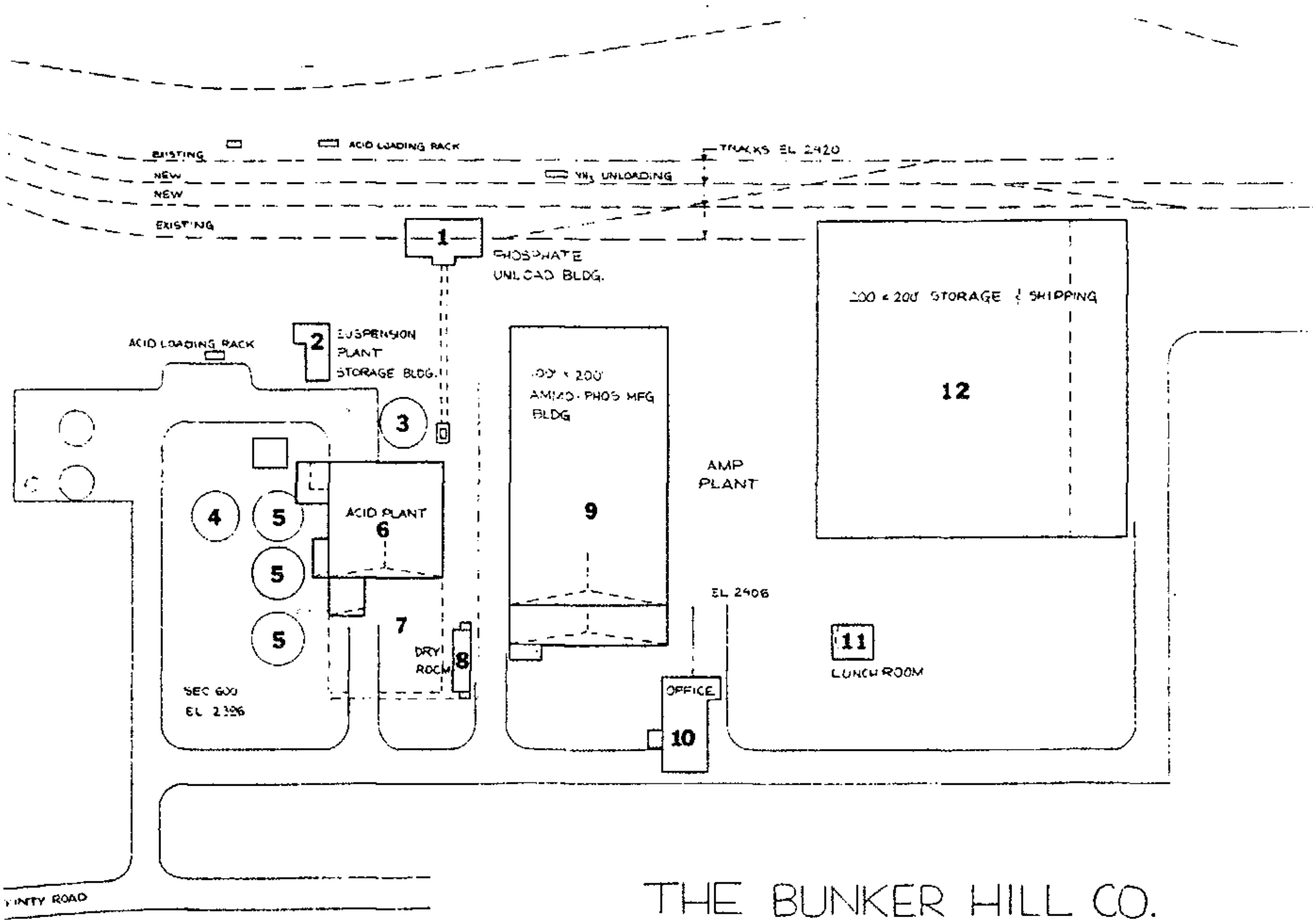
Ammonium Phosphate Fertilizers were manufactured in this facility, using acids from the Phosphoric Acid Plant, sulfuric acid (H_2SO_4), and ammonia (NH_3).

10.) <u>Office</u>: Built 1965 (wood frame); 1,719 sq. ft.

11.) <u>Lunchroom</u>: Built 1973 (wood frame); 546 sq. ft.

12.) <u>Storage and Shipping Warehouse</u>: Built 1965 (wood frame); 40,000 sq. ft.

Manufactured fertilizers were stored in bulk and bagged form for eventual rail and truck shipment to consumers.



THE BUNKER HILL CO.
NORTH IDAHO PHOSPHATE PLANT
KELLOGG, IDAHO
Scale 1" = 50'
January 1977
THE AMERICAN APPRAISAL COMPANY

Figure 1

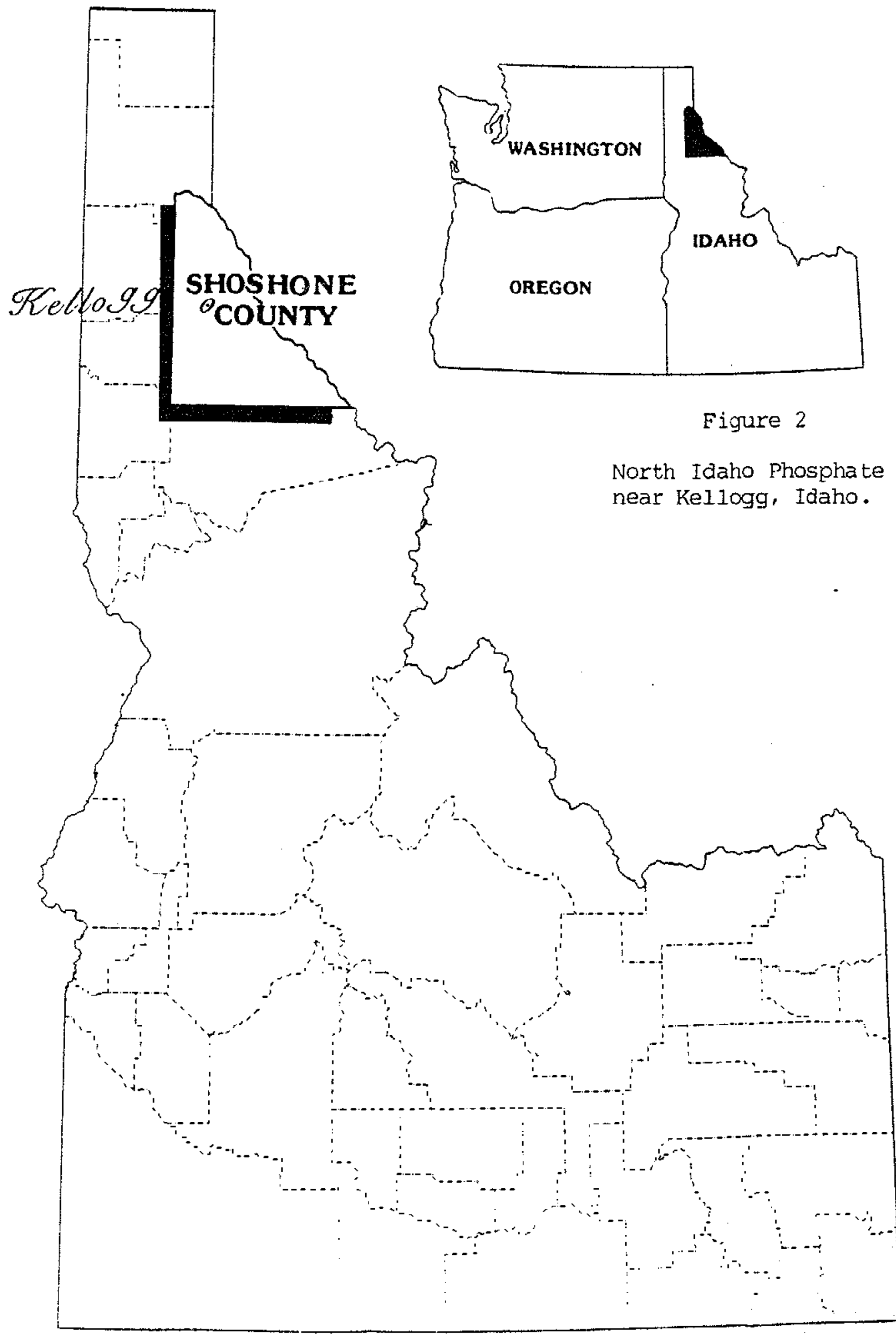


Figure 2

North Idaho Phosphate Co.
near Kellogg, Idaho.

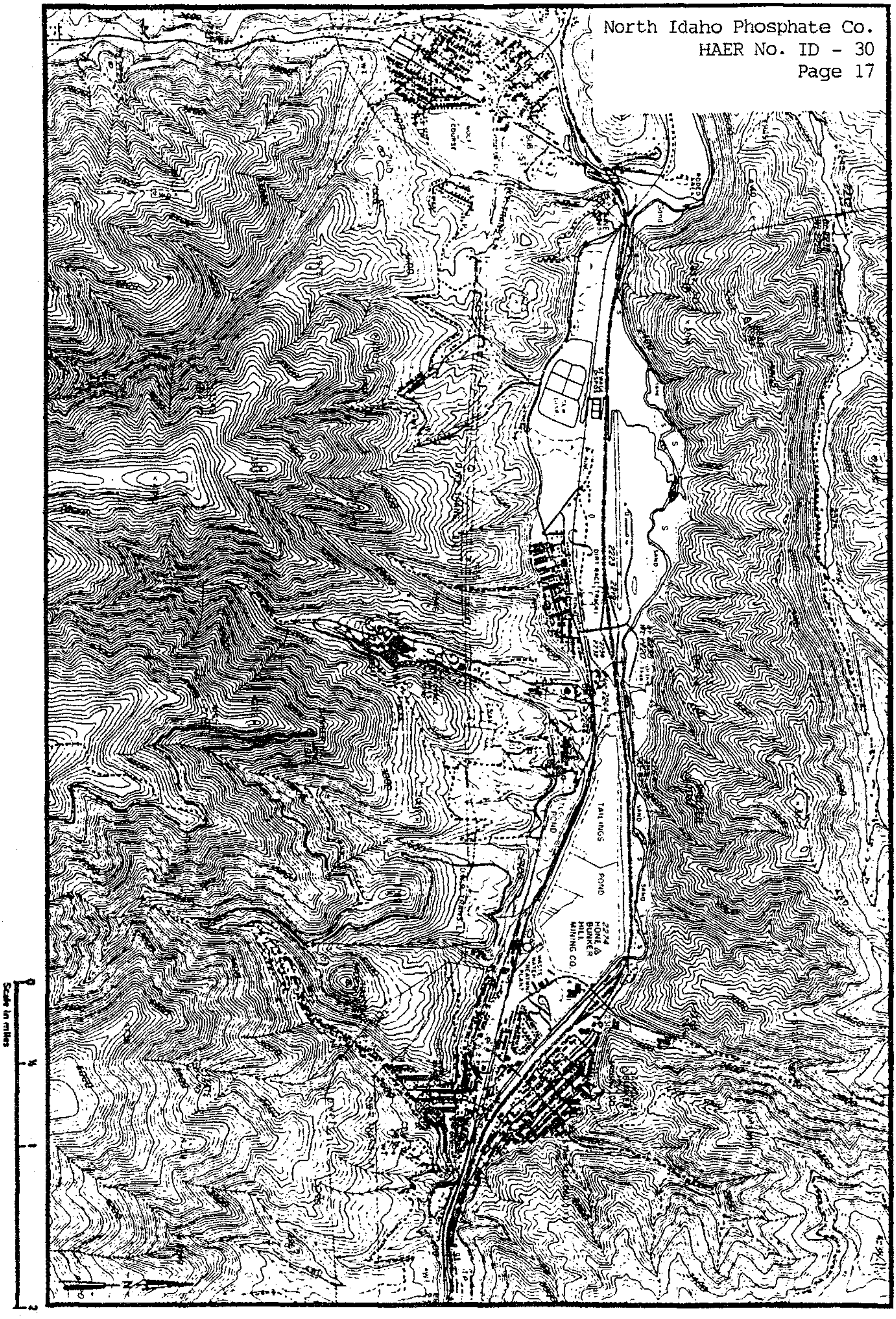


Figure 3
Kellogg Area

1 = Bunker Hill Lead Smelter K = Kellogg
2 = North Idaho Phosphate Co. S = Smelterville
3 = Sullivan Electrolytic Zinc Plant

NOTES

1.Dean Wilde, "The Phosphate Fertilizer Industry Relationship to SO_2 Recovery," 5, 9, unpublished Bunker Hill Lead Smelter Research Department paper, 15 August 1951, Pintlar Documents Storage Record (hereinafter PDSR).

2.A. E. Nugent to Keith J. Droste, "Review of Montana Phosphate Holdings," 2-3, Bunker Hill interoffice memorandum, 14 May 1970, P.D.S.R.

3."Kellogg Chosen for Fertilizer Site," Bunker Hill Reporter, 4, no. 9 (1959), 1. The Bunker Hill Reporter was a monthly newspaper issued by Bunker Hill's Employee and Public Relations Division. Bound copies are on file at the Kellogg Public Library, Kellogg, Idaho.

4.LeVern M. Griffith and Emmett Waltman to Wallace Woolf, "Memorandum," 18 November 1958, 1-4, P.D.S.R.

5.Ibid, 4-6.

6.LeVern M. Griffith to Wallace Woolf, "Memorandum," 27 June 1959, 1-4, P.D.S.R. Rail transport in tank cars would have provided another means of supplying Kennewick with H_2SO_4.

7.T.B. Ford, Dorr-Oliver, Inc., "Agreement For The Design, Engineering, And Purchase Of Equipment For A Phosphoric Acid Plant For The Bunker Hill Company To Be Located At Kellogg, Idaho," 1, 23 September 1959, P.D.S.R.

8."Arrangement Completed- Bunker Hill to Produce Acid for California Firm," Bunker Hill Reporter, 5, no. 7 (1960), 1. Production was scheduled for 1961, but did not commence until 1965 (Kenneth C. Haight, telephone interview by author, 13 September 1993, Coeur d'Alene, Idaho).

9.Oliver W. Hall, "Insurance Engineering Report," 2, San Francisco: Marsh & McLennan-Cosgrove & Company, 25 March 1961, P.D.S.R.

10.Joseph D. Acree, interview by author, 27 May 1993, Hayden Lake, Idaho.

11.Peter M. Jasberg, "Bunker Hill Acid And Fertilizer Production," 9, in "Affidavit of Peter M. Jasberg," P.D.S.R.

12.Ibid.

13.Ibid.

14.Raymond Dose, interview by author, 8 April 1983, Pine Creek, Idaho. Mr. Dose was a maintenance supervisor at the Phosphoric Acid/Fertilizer Plant.

15.Jasberg, "Bunker Hill Acid and Fertilizer Production," 10.

16.Ibid.

17.Ibid, 11.

18.Ibid.

19.Ibid, 12.

20.Acree, 27 May 1993.

21.Jasberg, "Bunker Hill Acid and Fertilizer Production," 12.

22.Ibid.

23.Ibid, 13.

24."First Shipment of Acid Sent From New Plant," Bunker Hill Reporter, 6, no. 2 (1961), 1. The delay between plant completion and product shipment was due to the labor stoppage that affected Bunker Hill's Kellogg operations during May-December, 1960.

25."Bunker Hill's Acid Plant is In Production," Bunker Hill Reporter, 6, no. 1 (1961), 1.

26."First Shipment of Acid Sent From New Plant," Bunker Hill Reporter, 1. Mr. Wilde joined the J. R. Simplot Company soon after the Phosphoric Acid plant began operations, and he perished in an aviation accident; he was succeeded as Superintendent of the plant by K. C. Haight.

27."Acid Storage Tank" (captioned photograph), Bunker Hill Reporter, 6, no. 7 (1961), 4.

28."Fertilizer Plant," 2, unpublished and undated paper, with no author listed, contained in the "J. E. McKay File," P.D.S.R.

29.Jasberg, "Bunker Hill Acid and Fertilizer Production," 13.

30.Ibid; "Fertilizer Plant," 2.

31.Jasberg, "Bunker Hill Acid and Fertilizer Production," 13.

32.Joseph D. Acree, telephone interview by author, 15 September 1993, Hayden Lake, Idaho. Mr. Acree said that foam was used as the insulation agent, and that it limited heat loss to 1° F. per day.

33."Joint Venture Agreement Between Stauffer Chemical Company and The Bunker Hill Company," P.D.S.R.

34."Joint Venture Committee Minutes," North Idaho Phosphate Company, 17 December 1964, P.D.S.R.

35.Acree, 27 May 1993.

36."Northwest Crops Stay Green With BH Fertilizer Production," Bunker Hill Reporter, 15, no. 10 (1970), 3.

37.Raymond Dose, interview by author, 2 June 1993, Pine Creek, Idaho. Mr. Dose said that agricultural production in the Pacific Northwest was a "high nitrogen" consumer, with little need for additional potash. He said that the North Idaho Phosphate Plant didn't have the additional feeders needed for potash, and that the cost of this material was influenced by the plant's distance from the main source of it at Carlsbad, New Mexico.

38."Joint Venture Agreement Between Stauffer Chemical Company and The Bunker Hill Company," 7,11, P.D.S.R.

39."Bunker-Stauffer Fertilizer Plant Opens This Month," Bunker Hill Reporter, 10, no. 11 (1965), 1.

40.Dose, 2 June 1993.

41.Jasberg, "Bunker Hill Acid and Fertilizer Production," 15.

42.Dose, 2 June 1993. Mr. Dose said that fertilizer plants used sand as the initial material in pug mill pellet formation, with the resultant product being sold as an off-grade fertilizer, or else it was combined with subsequent production and brought up to grade.

43.Jasberg, "Bunker Hill Acid and Fertilizer Production," 15-16.

44.Acree, 27 May 1993.

45.G. A. Larson to C. E. Schwab, "Memorandum," 13 April 1967, P.D.S.R.

46."Company Will Build Second Fertilizer Plant," Bunker Hill Reporter, 13, no.4 (1968), 1.

47.Dose, 8 April 1993.

48."Mile Long Pipeline Planned For Fertilizer Plant Waste," Bunker Hill Reporter, 14, no.4 (1969), 1.

49.Jasberg, "Bunker Hill Acid and Fertilizer Production," 14.

50.Joseph D. Acree to Frank G. Woodruff, 15 December 1970, P.D.S.R.

51."1972 Fertilizer Sales to Set Record," Bunker Hill Reporter, 16, no.11 (1972), 1.

52.Fred Camm, interview by author, 4 June 1993, Pinehurst, Idaho. Mr. Camm used to operate the equipment used in this process. Truck transport was preferred over rail tank-cars, due to uneven settling of the suspended material.

53."1975 Fertilizer Sales Down," Bunker Hill Reporter, 19, no.12 (1975), 4.

54."Joint Venture Committee Minutes," North Idaho Phosphate Company, 5 November 1980 and 16 June 1981, P.D.S.R.

55."The Phosphoric Acid-Fertilizer Plant" (captioned photograph), 2, Bunker Hill Reporter 16, no. 6 (1971).

56.Charles P. Blickle, "Exhibit B: Schedule of Buildings and Land Improvements- Construction NIPCO," 26, in "Appraisal Report- The Bunker Hill Company," Milwaukee: American Appraisal Company, 1977; "Company's Phosphoric Acid Plant Operations Pictured," Bunker Hill Reporter 6, no. 4 (1961), 3; "Acid Storage Tank," Bunker Hill Reporter 6, no. 7 (1961), 4; "Fertilizer Plant Operations Highly Complex," Bunker Hill Reporter 11, no. 2 (1966),3; Frederick Camm, interview by author, 4 June 1993, Pinehurst, Idaho.

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"Kellogg Chosen for Fertilizer Site." <u>Bunker Hill Reporter</u> 4, no. 9 (1959).

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Hall, Oliver W. "Insurance Engineering Report." San Francisco: Marsh & McLennan-Cosgrove & Company, 25 March 1961. P.D.S.R.

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________. Interview by author, 2 June 1993, Pine Creek, Idaho.

Haight, Kenneth C. Telephone interview by author, 13 September 1993, Coeur d'Alene, Idaho.